

What is Claimed is:

CLAIMS

1. A fluid ejection assembly, comprising:
at least one inner layer having a fluid passage defined therein; and
first and second outer layers positioned on opposite sides of the at least one inner layer, the first and second outer layers each having a side adjacent the at least one inner layer and including drop ejecting elements formed on the side and fluid pathways communicated with the drop ejecting elements,
wherein the fluid pathways of the first and second outer layers communicate with the fluid passage of the at least one inner layer, and
wherein the at least one inner layer and the fluid pathways of the first outer layer form a first row of nozzles, and the at least one inner layer and the fluid pathways of the second outer layer form a second row of nozzles.
2. The fluid ejection assembly of claim 1, wherein the at least one inner layer includes a single inner layer having a first side and a second side opposite the first side, wherein the first outer layer is adjacent the first side and the second outer layer is adjacent the second side.
3. The fluid ejection assembly of claim 2, wherein the fluid passage of the at least one inner layer includes an opening communicated with the first side and the second side of the single inner layer and extended between opposite ends of the single inner layer.
4. The fluid ejection assembly of claim 1, wherein the at least one inner layer includes a first inner layer adjacent the first outer layer, a second inner layer adjacent the second outer layer, and a third inner layer interposed between the first inner layer and the second inner layer.

5. The fluid ejection assembly of claim 4, wherein the fluid passage of the at least one inner layer includes a first plurality of openings formed in the first inner layer, a second plurality of openings formed in the second inner layer, and a third plurality of openings formed in the third inner layer, wherein the third plurality of openings communicate with the first plurality of openings and the second plurality of openings when the third inner layer is interposed between the first inner layer and the second inner layer.
6. The fluid ejection assembly of claim 1, wherein the drop ejecting elements of the first outer layer are adapted to eject drops of fluid through the first row of nozzles substantially parallel to the side of the first outer layer, and wherein the drop ejecting elements of the second outer layer are adapted to eject drops of fluid through the second row of nozzles substantially parallel to the side of the second outer layer.
7. The fluid ejection assembly of claim 1, wherein the first and second outer layers each have an edge contiguous with the side thereof, wherein the first row of nozzles extend along the edge of the first outer layer and the second row of nozzles extend along the edge of the second outer layer.
8. The fluid ejection assembly of claim 1, wherein the at least one inner layer and the first and second outer layers each include a common material, wherein the common material includes one of glass, a ceramic material, a carbon composite material, metal, and a metal matrix composite material.
9. The fluid ejection assembly of claim 1, wherein each of the fluid pathways of the first and second outer layers include a fluid inlet, a fluid chamber communicated with the fluid inlet, and a fluid outlet communicated with the fluid chamber, and wherein each of the drop ejecting elements of the first and second outer layers include a firing resistor formed within the fluid chamber of one of the fluid pathways.

10. The fluid ejection assembly of claim 9, wherein the first and second outer layers each include a substrate and a thin-film structure formed on the substrate, wherein the firing resistor of each of the drop ejecting elements is formed on the thin-film structure of the first and second outer layers.
11. The fluid ejection assembly of claim 10, wherein the substrate of each of the first and second outer layers includes a non-conductive material.
12. The fluid ejection assembly of claim 11, wherein the non-conductive material includes one of glass, a ceramic material, a carbon composite material, and an oxide formed on one of a metal and a metal matrix composite material.
13. The fluid ejection assembly of claim 10, wherein the thin-film structure includes drive circuitry of the drop ejecting elements.
14. The fluid ejection assembly of claim 13, wherein the drive circuitry includes thin-film transistors.
15. The fluid ejection assembly of claim 10, wherein the first and second outer layers each include barriers formed between the fluid pathways, wherein the barriers are formed on the thin-film structure of the first and second outer layers.
16. The fluid ejection assembly of claim 15, wherein the barriers are formed of one of a photo-imageable polymer and glass.
17. The fluid ejection assembly of claim 1, wherein the at least one inner layer further includes at least one fluid port communicated with the fluid passage.

18. The fluid ejection assembly of claim 1, wherein the first row of nozzles and the second row of nozzles span a distance less than approximately two inches.

19. The fluid ejection assembly of claim 1, wherein the first row of nozzles and the second row of nozzles span a distance greater than approximately two inches.

20. The fluid ejection assembly of claim 1, wherein each nozzle of the first row of nozzles is substantially aligned with one nozzle of the second row of nozzles.

21. The fluid ejection assembly of claim 1, wherein each nozzle of the first row of nozzles is offset from one nozzle of the second row of nozzles.

22. A method of forming a fluid ejection assembly, the method comprising:
defining a fluid passage in at least one inner layer;

forming drop ejecting elements on a side of each of first and second outer layers;

forming fluid pathways on the side of each of the first and second outer layers, including communicating the fluid pathways with the drop ejecting elements; and

positioning the first and second outer layers on opposite sides of the at least one inner layer, including communicating the fluid pathways of the first and second outer layers with the fluid passage of the at least one inner layer, and forming a first row of nozzles with the at least one inner layer and the fluid pathways of the first outer layer and forming a second row of nozzles with the at least one inner layer and the fluid pathways of the second outer layer.

23. The method of claim 22, wherein defining the fluid passage includes defining the fluid passage in a single inner layer having a first side and a second side opposite the first side, wherein positioning the first and second outer layers

includes positioning the first outer layer adjacent the first side and positioning the second outer layer adjacent the second side.

24. The method of claim 23, wherein defining the fluid passage in the single inner layer includes communicating an opening with the first side and the second side of the single inner layer and extending the opening between opposite ends of the single inner layer.

25. The method of claim 22, wherein defining the fluid passage includes defining the fluid passage in a first inner layer, a second inner layer, and a third inner layer interposed between the first inner layer and the second inner layer, wherein positioning the first and second outer layers includes positioning the first outer layer adjacent the first inner layer and positioning the second outer layer adjacent the second inner layer.

26. The method of claim 25, wherein defining the fluid passage in the first inner layer, the second inner layer, and the third inner layer includes forming a first plurality of openings in the first inner layer, forming a second plurality of openings in the second inner layer, and forming a third plurality of openings in the third inner layer, wherein the third plurality of openings communicate with the first plurality of openings and the second plurality of openings when the third inner layer is interposed between the first inner layer and the second inner layer.

27. The method of claim 22, wherein the drop ejecting elements of the first outer layer are adapted to eject drops of fluid through the first row of nozzles substantially parallel to the side of the first outer layer, and wherein the drop ejecting elements of the second outer layer are adapted to eject drops of fluid through the second row of nozzles substantially parallel to the side of the second outer layer.

28. The method of claim 22, wherein forming the first row of nozzles includes forming the first row of nozzles along an edge of the first outer layer adjacent

the side thereof, and forming the second row of nozzles includes forming the second row of nozzles along an edge of the second outer layer adjacent the side thereof.

29. The method of claim 22, wherein the at least one inner layer and the first and second outer layers each include a common material, wherein the common material includes one of glass, a ceramic material, a carbon composite material, metal, and a metal matrix composite material.

30. The method of claim 22, wherein forming each of the fluid pathways includes forming a fluid inlet, communicating a fluid chamber with the fluid inlet, and communicating a fluid outlet with the fluid chamber, and wherein forming each of the drop ejecting elements includes forming a firing resistor within the fluid chamber of one of the fluid pathways.

31. The method of claim 30, further comprising:
forming the first and second outer layers, including forming a thin-film structure on a substrate of each of the first and second outer layers,
wherein forming the drop ejecting elements includes forming the firing resistor of each of the drop ejecting elements on the thin-film structure of the first and second outer layers.

32. The method of claim 31, wherein the substrate of each of the first and second outer layers includes a non-conductive material.

33. The method of claim 32, wherein the non-conductive material includes one of glass, a ceramic material, a carbon composite material, and an oxide formed on one of a metal and a metal matrix composite material.

34. The method of claim 31, wherein forming the thin-film structure includes forming drive circuitry of the drop ejecting elements.

35. The method of claim 34, wherein forming the drive circuitry of the drop ejecting elements includes forming thin-film transistors.
36. The method of claim 31, wherein forming the fluid pathways includes forming barriers on the thin-film structure of the first and second outer layers between the fluid pathways.
37. The method of claim 36, wherein the barriers are formed of one of a photo-imageable polymer and glass.
38. The method of claim 22, further comprising:
defining at least one fluid port in the at least one inner layer, including communicating the at least one fluid port with the fluid passage.
39. The method of claim 22, wherein forming the first row of nozzles and forming the second row of nozzles includes extending the first row of nozzles and the second row of nozzles a distance less than approximately two inches.
40. The method of claim 22, wherein forming the first row of nozzles and forming the second row of nozzles includes extending the first row of nozzles and the second row of nozzles a distance greater than approximately two inches.
41. The method of claim 22, wherein forming the first row of nozzles and forming the second row of nozzles includes substantially aligning each nozzle of the first row of nozzles with one nozzle of the second row of nozzles.
42. The method of claim 22, wherein forming the first row of nozzles and forming the second row of nozzles includes offsetting each nozzle of the first row of nozzles from one nozzle of the second row of nozzles.
43. A fluid ejection assembly, comprising:

first and second layers spaced from and facing each other;
fluid pathways formed on the first and second layers;
drop ejecting elements each communicated with one of the fluid pathways;
means interposed between the first and second layers for routing fluid to the fluid pathways; and
means for forming nozzles for the drop ejecting elements.

44. The fluid ejection assembly of claim 43, wherein means for routing fluid to the fluid pathways includes at least one layer interposed between the first and second layers and having a fluid passage defined therein.

45. The fluid ejection assembly of claim 44, wherein the at least one layer and the first and second layers each include a common material, wherein the common material includes one of glass, a ceramic material, a carbon composite material, metal, and a metal matrix composite material.

46. The fluid ejection assembly of claim 43, wherein means for forming nozzles for the drop ejecting elements includes at least one layer interposed between the first and second layers, wherein the at least one layer and the fluid pathways on the first layer form a first plurality of the nozzles, and the at least one layer and the fluid pathways on the second layer form a second plurality of the nozzles.

47. The fluid ejection assembly of claim 43, wherein the drop ejecting elements are formed on a side of each of the first and second layers, and wherein the drop ejecting elements are adapted to eject drops of fluid through the nozzles substantially parallel to the side of each of the first and second layers.

48. The fluid ejection assembly of claim 43, wherein the first and second layers each include a substrate and a thin-film structure formed on the

substrate, wherein the drop ejecting elements are formed on the thin-film structure of the first and second layers.

49. The fluid ejection assembly of claim 48, wherein the thin-film structure includes drive circuitry of the drop ejecting elements, wherein the drive circuitry includes thin-film transistors.

50. The fluid ejection assembly of claim 48, further comprising:
barriers formed on the thin-film structure of the first and second layers between the fluid pathways.

51. A method of operating a fluid ejection assembly, the method comprising:
routing fluid to fluid pathways formed on first and second outer layers positioned on opposite sides of at least one inner layer, including distributing the fluid to the fluid pathways through a fluid passage defined in the at least one inner layer; and
ejecting drops of the fluid from drop ejecting elements formed on the first and second outer layers and each communicated with one of the fluid pathways, including ejecting drops of the fluid through a first row of nozzles formed with the at least one inner layer and the fluid pathways of the first outer layer and ejecting drops of the fluid through a second row of nozzles formed with the at least one inner layer and the fluid pathways of the second outer layer.

52. The method of claim 51, wherein routing fluid to the fluid pathways includes routing fluid to a fluid chamber of each of the fluid pathways, and wherein ejecting drops of the fluid includes ejecting the drops with firing resistors each formed within the fluid chamber of one of the fluid pathways.

53. The method of claim 51, wherein ejecting drops of the fluid includes ejecting drops through the first row of nozzles and the second row of nozzles

substantially parallel to a side of each of the first and second outer layers on which the drop ejecting elements are formed.

54. The method of claim 51, wherein ejecting drops of the fluid includes operating the drop ejecting elements with drive circuitry formed in a thin-film structure of each of the first and second outer layers.

55. The method of claim 54, wherein routing fluid to the fluid pathways includes routing fluid between barriers formed on the thin-film structure of each of the first and second outer layers.